Space Weather Technical Forecast

Issued on Tuesday 15 October 2024 at 13:15 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Chance G1 Minor Geomagnetic Storm day 1 (15 Oct). Chance of isolated M-flares persists.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate activity with a peak flare of M1.9 at 15/0213 UTC from the AR3852/AR3854 regions in the south-centre disc. There are seven sunspot regions on the Earth facing disc. AR3848 has rotated out of view around the northwest limb. AR3852 and AR3854 in the south-centre form a coupled pair of sunspots, and are responsible for the majority of flare activity. While simplifying in visible appearance with the loss of intermediate spots, the regions continue to show some modest magnetic loop structure. AR3850 and AR3849 in the southwest also form a closely connected pair of spots, but are magnetically fairly simple in appearance. The two new regions on the east limb currently appear simple and relatively inactive.

A number of CMEs have been observed in imagery, however these are all off the Earth-Sun line, and not thought Earth-directed.

Solar Wind / Geomagnetic Activity: Solar winds were initially at background levels, around 380km/s. An increase in speeds was recorded following a weak CME arrival at approximately 14/1717 UTC, with wind speeds generally around 400-420km/s, with a brief maximum of around 450km/s. Density initially below average, rose to near average levels following the CME arrival. The Interplanetary Magnetic Field (IMF), Bt, was weak below 5nT to start, then increasing following CME arrival to become moderate, peaking close to 10nT. The north-south component, Bz, varied weakly initially, becoming generally weakly negative following CME arrival, with a low of -7nT. Phi angle was positive (Away from the Sun) throughout. Geomagnetic activity was mostly Quiet to Unsettled (Kp1-3), with an Active (Kp4) period between 14/2100-15/0000 UTC.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was persistently Moderate with peak 638 pfu at 14/1845 UTC. The associated 24-hour fluence was below the Active. The 15/0000UTC observation was 2.34e7 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Solar Wind / Geomagnetic Activity: Ongoing slightly elevated solar winds and weak CME influence are expected to gradually ease through day 1 (15 Oct). However, there is a potential for elevated winds to return for a time on days 1-2 (15-16 Oct) due to any further transitory CME influence or a possible connection to coronal hole fast winds. A more notable coronal hole enhancement is possible into day 4 (18 Oct) and beyond in association with the large CH80/+, currently near centre disk.

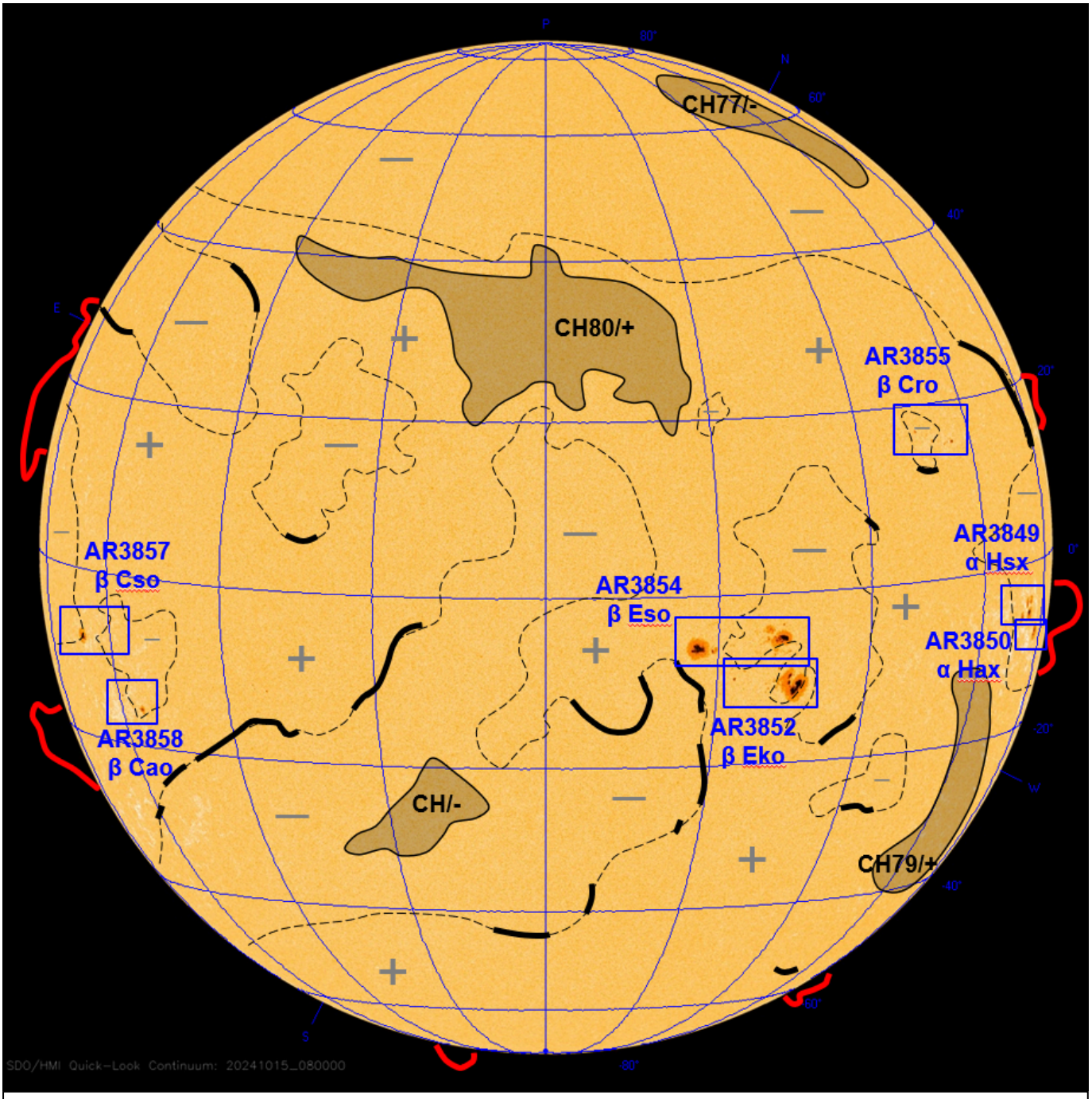
Overall geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with CME arrival or coronal hole influence, and there is a chance of isolated G1 Minor Storm intervals day 1 (15 Oct) given uncertainty with potential CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES-18 is now largely at background, but there remains a slight chance of further enhancements given any significant flares. High energy electron flux is expected to continue rising as solar winds ease and the Van Allen belts expand outward again. This brings a chance of High flux, although tempered by any possible CME arrival or fast wind onset. The associated 24 hour fluence is expected to rise, but thought likely to remain generally below Active (1e8 total pfu).

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 1: Solar Synoptic Map valid 15/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Storms

There is one potential Earth glancing CME in the forecast. This originated from an M2.1 flare from AR3854 in the east disc, with a glancing impact most likely on day 1 (15 Oct). The arrival time of this feature is low confidence, due to limited imagery for analysis, and may already be influencing the near Earth environment.

Ongoing slightly elevated solar winds and weak CME influence are expected to gradually ease through day 1 (15 Oct). However, there is a potential for elevated winds to return for a time on days 1-2 (15-16 Oct) due to any further transitory CME influence or a possible connection to coronal hole fast winds from CH79/+ in the southern disc. While this coronal hole was present on the previous rotation and showed no notable enhancement, it now displays a more northward extension. Confidence remains low for this being observed however, with Earth currently north of the ecliptic. A more notable coronal hole enhancement is possible into day 4 (18 Oct) and beyond in association with the large CH80/+, currently near centre disk. This feature is significantly larger and more clearly defined than the previous rotation, and an increase in solar winds towards slightly elevated to elevated speeds looks likely by the end of the period.

MOSWOC ENLIL output is providing little guidance. Currently over-estimating the extent of the fast wind from the southern disc, and has little signal for CH80/+ later in the period. This likely due to current limitations with GONG H-alpha imagery that is used for the initialisation of the model.

Overall geomagnetic activity is expected to be mainly Quiet to Unsettled. There is a likelihood of Active intervals both to start and end the forecast associated with CME arrival or coronal hole influence, and there is a chance of isolated G1 Minor Storm intervals day 1 (15 Oct) given uncertainty with potential CME arrival.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	No	30	10	1	10
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

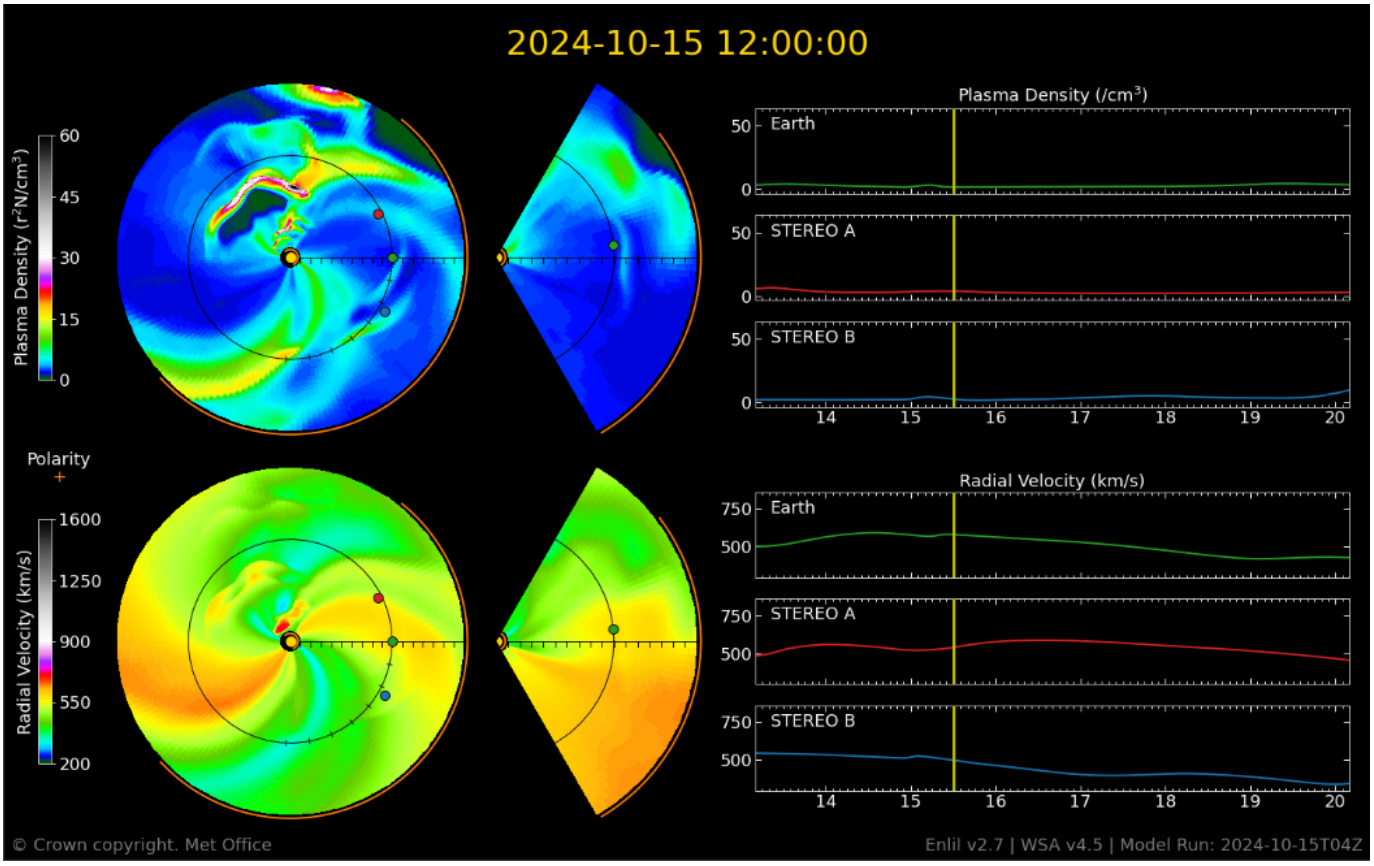
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
12/0102	Nil	AR3854	27E 01S	480	Early 15 Oct	Low confidence. Glancing impact at most.

Figure 2: MOSWOC Enlil model



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Radio Blackouts - X-Ray Flares

There are seven visible sunspot regions on the Earth facing disc, with AR3848 having recently rotated round the western limb. This region will continue to contribute to the flare risk in the short term however. AR3852 and AR3854 in the south-centre form a coupled pair of sunspots, and have been responsible for the majority of flare activity during the period. While simplifying in visible appearance with the loss of intermediate spots, the regions continue to show some modest magnetic looping structure in e.g. SDO aia-211. AR3850 and AR3849 in the southwest also form a closely connected region of spots, but are now largely consisting of a cluster of negative polarity spots with few very small positive polarity spots identifiable. The two new regions on the east limb currently appear simple.

Low to Moderate activity is expected, with an ongoing chance of isolated M-class flares. There is a slight chance of X-class flares, either from AR3848 just over the northwest limb, or the combination of AR3852/54.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	40	35	30	30
Very Active	R3-R5 (X Class)	No	5	5	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 3: GOES-16 & -18 X-ray flux

© Crown Copyright 2024. All Rights Reserved.

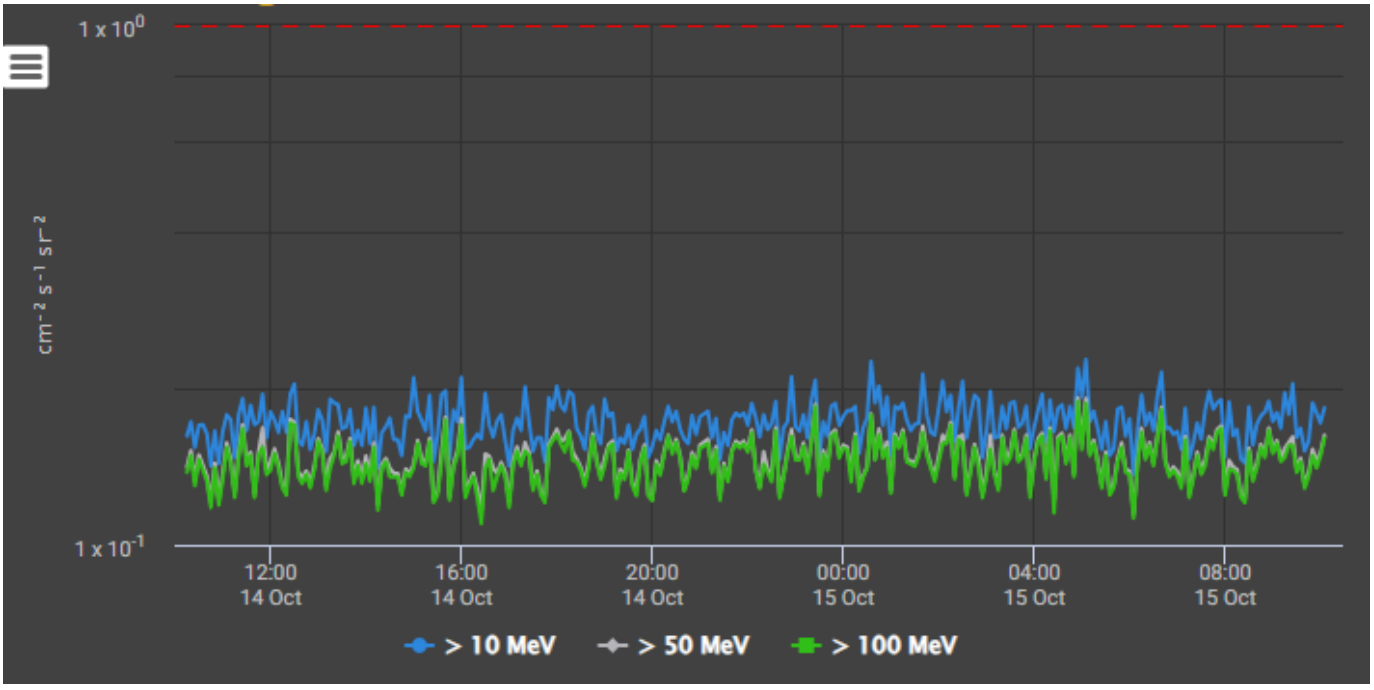
Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but there remains a slight chance of enhancement given any notable flares, primarily from AR3848 in the near term from over the western limb, but also possible from any AR3852/54 flares, especially as this region moves further onto the western disc.

Any enhancement will bring a slight chance of reaching the S1 Minor Radiation Storm threshold.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 Proton flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES-16 have recently been persistently Moderate, but have since fallen back to background following a transient CME arrival during the UTC evening of 14 Oct. The recent significant CME arrival and subsequent strong solar winds have likely increased counts at lower orbits, with the Van Allen belts compressed inward by the ongoing solar wind pressure. As solar winds ease, flux is expected to rise at GEO to become Moderate to High with a chance of becoming perhaps persistently High from day 1 (15 Oct). However, this is low confidence, and confidence is further lowered by ongoing and further potential CME arrivals into the early part of the period or high speed stream onset by day 4 (18 Oct). Any such enhancement is likely to suppress flux at GEO to background levels again, but with low confidence

The associated electron fluence is therefore expected to be below the Active level (1e8 total pfu), but with a rising trend to start. This will bring a increasing chance of Active fluence into days 2 and 3 (16-17 Oct). MOSWOC REFM model output is not viewed as providing significant guidance due to the impact of recent CMEs.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	20	30	30	20
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

Figure 5: MOSWOC REFM

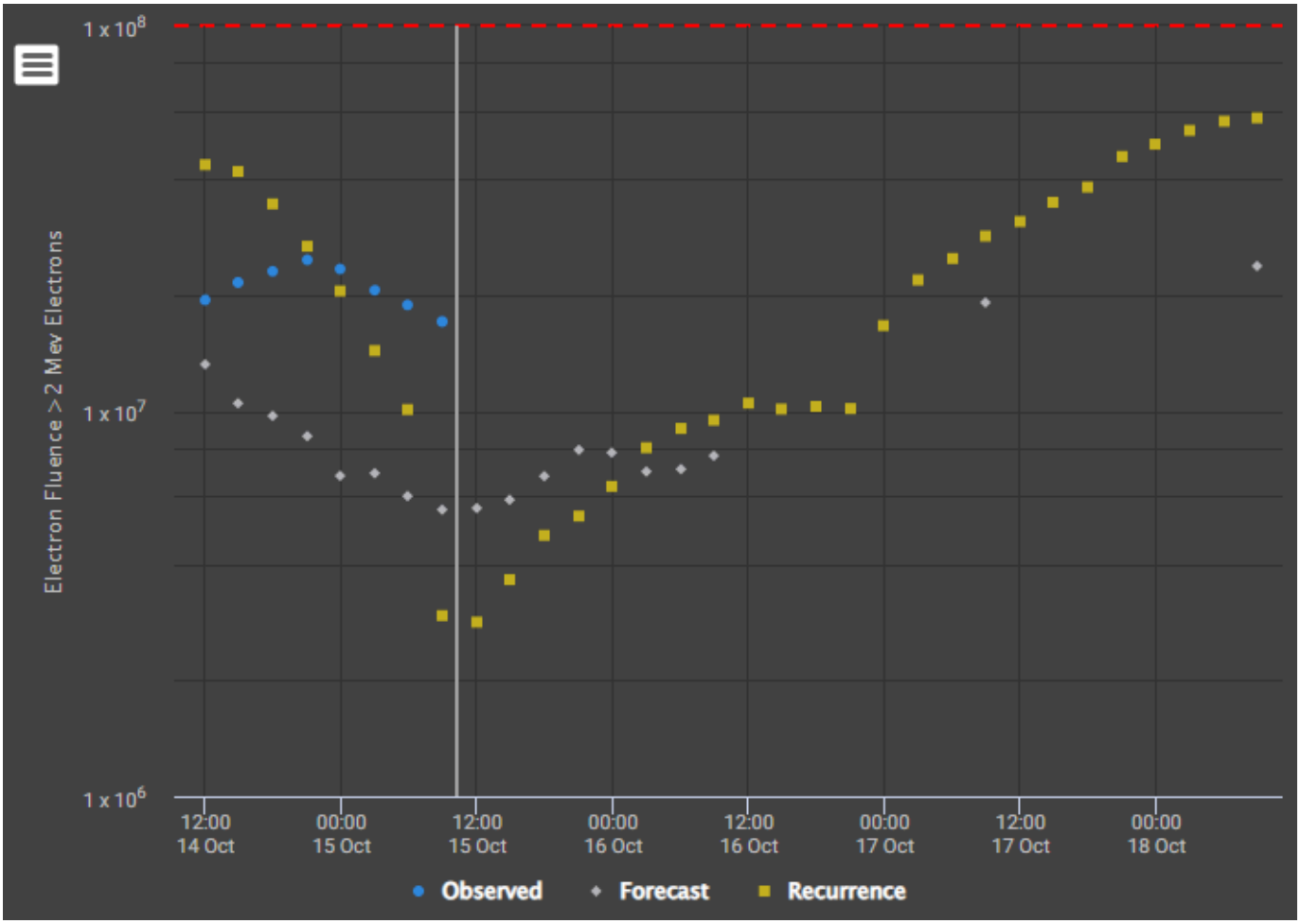
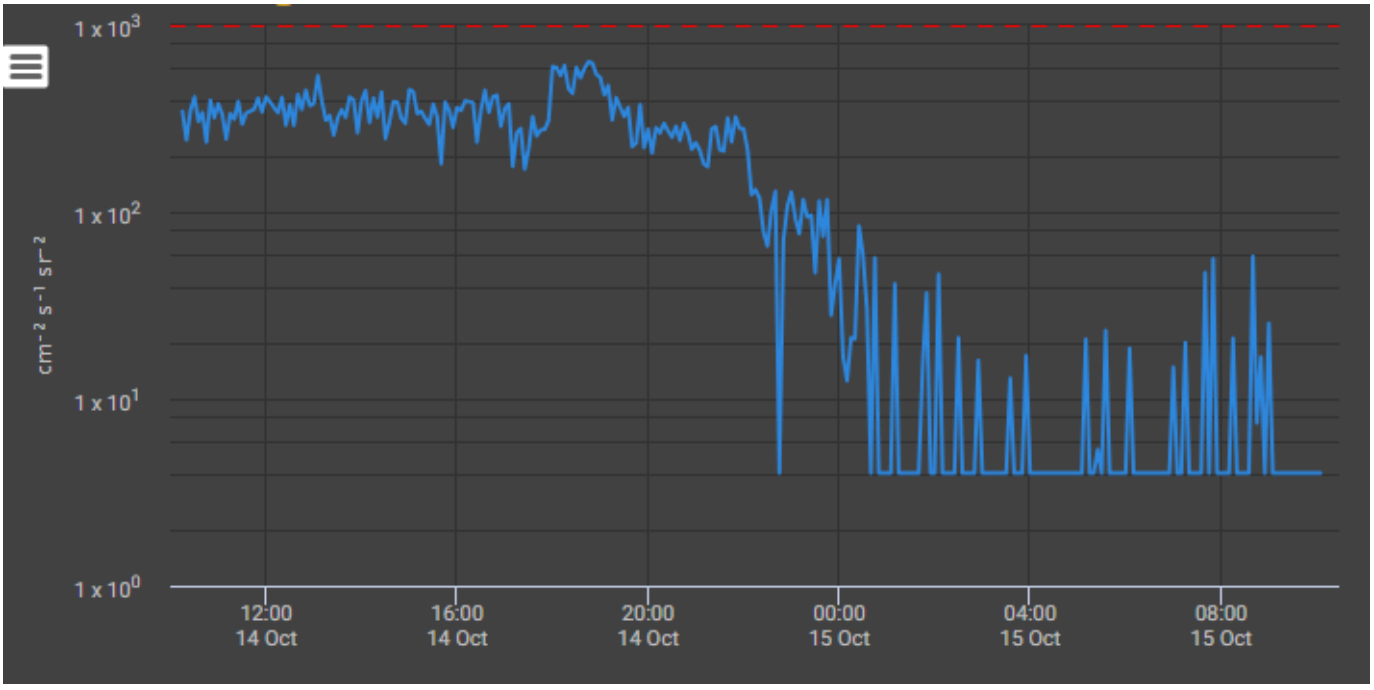


Figure 6: GOES-16 Electron flux



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.